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Source: *The Scientific Monthly*, Vol. 46, No. 2 (Feb., 1938), pp. 180-187

Published by: American Association for the Advancement of Science

Stable URL: <https://www.jstor.org/stable/16467>

Accessed: 07-11-2018 23:33 UTC

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SAN MIGUEL ISLAND, CALIFORNIA

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OFF the coast of Southern California, for the most part in plain sight from the mainland, are eight islands. They are divided into two groups, northern and southern. The northern islands, arranged in a row east and west, are San Miguel (the outermost), Santa Rosa, Santa Cruz and Anacapa. The southern are Santa Catalina, San Clemente, Santa Barbara and San Nicolas. Geologists suppose that during the Tertiary Epoch there was a land, which has been called Catalinia, extending from the northern islands southward, including the southern islands and the vicinity of San Pedro on the present mainland, and possibly going as far as Guadalupe Island, far out in the Pacific. How much of this land persisted into the Pleistocene remains uncertain, but during the latest geological period there were undoubtedly great changes of level. During the Tertiary, maritime conditions are shown by the presence of numerous Eocene and Miocene sea shells fossil on Santa Cruz. Chaney and Mason postulate a peninsula in Pleistocene times, extending westward from south of Ventura and including all the northern islands. This leaves us to suppose that the southern islands were independently connected with the mainland, but there is a comparatively shallow bank (the greatest depth 96 fathoms) extending from Santa Rosa to San Nicolas. That the islands were really connected with the mainland during the Pleistocene appears to be proved by the occurrence of remains of mammoths (*Elephas*) on Santa Cruz, Santa Rosa and San Miguel, and the endemic salamanders (*Batrachoseps*) on Catalina and the northern islands. Chaney and Mason describe a formation of Pleistocene age,

on Santa Cruz, containing a flora similar to that in the vicinity of Fort Bragg, about 440 miles N.-N.W. This includes large logs of Douglas fir (*Pseudotsuga taxifolia*), wood and cones of cypress (*Cupressus goveniana*), seeds of *Garrya elliptica*, and in general a flora differing almost entirely from that now on Santa Cruz and not ancestral to it. The only species still existing on Santa Cruz is the pine tree, *Pinus remorata*, which must formerly have had a very wide distribution, since it is found on Cedros Island, off the coast of Lower California. We apparently must conclude that a Pleistocene fauna and flora which inhabited the islands at one time has entirely or almost entirely disappeared, to be replaced by the quite different assemblage we find to-day. When these changes took place, and under what conditions, we do not know. Munz gives a list of 35 kinds of plants, found to-day on the northern islands, which occur on the mainland mostly from Monterey County northward. These may well have inhabited the mainland of Santa Barbara County (one of them, *Vaccinium ovatum*, does so to-day¹) when the climate was moister.

Whatever may have been the history of the islands, they are of great interest to the biologist to-day on account of the large number of peculiar (endemic) species and races found upon them. Taking the islands as a whole, there are about fifteen endemic mammals, fifteen birds, two lizards, two salamanders, sixteen land mollusks and over eighty flowering plants. Many insects are apparently en-

¹ As shown to me by Mr. M. Van Rensselaer, who also pointed out a grove of *Lithocarpus*, a tree not cited by Munz in his "Flora of Southern California."

demic, including a quite distinct butterfly on Catalina. Numerous fungi have been described from Santa Catalina, but whether any are truly endemic is uncertain. Some of them are found on introduced plants, such as *Eucalyptus* and *Nicotiana glauca*. These endemics may be classified under two headings. First, the relict endemics, which must have been much more widely distributed in former times, but now survive only on the islands. Second, the true island endemics, which acquired their special characters on the islands. Of the former type must be the wholly endemic genus of trees, *Lyonothamnus*, of which there are two forms, one only on Catalina, the other on Catalina, San Clemente, Santa Cruz and Santa Rosa. To the latter group we must assign the island foxes, having special races on Santa Catalina, San Clemente, San Nicolas, Santa Cruz, Santa Rosa and San Miguel. No one could imagine that there were six kinds of these foxes on the mainland, and on the islands being formed each took one for its own.

Although the ancient Catalina is presumed to have included all the islands, this is of no particular significance in relation to their present population, which must in the main date from quite late Pleistocene. It has been supposed that there were two extensions from the mainland, one in the north, as already indicated, the other southward, from somewhere near San Pedro. Reed suggests that San Pedro Hill is a "land-tied" member of the island group; it is at present largely covered with *Opuntia littoralis*, the prickly-pear so characteristic of the islands. If the islands were not connected north and south when the ancestors of the present populations mostly arrived, it is puzzling to explain why there are 21 kinds of plants and several birds which are island endemics, but occur on both the northern and southern groups. The birds may have acquired

their racial characters on one island, and reached the others by flight, aided perhaps by the strong prevailing winds. But if so, why has the very distinct Santa Cruz jay, abundant on that island, never crossed to any other? There are seven kinds of birds, each confined to a single island.

Otherwise, we have to ask whether the endemics, common to the two groups of islands, may have acquired their characters independently, so that they are now, so far as we can see, alike. A. B. Howell gives a summary of the characters of the endemic birds, showing that in general they have darker markings, larger bills and heavier or longer tarsi and toes.² Thus it would seem that there are environmental factors tending in certain directions, which might be expected to give parallel results on different islands. In the case of plants we may note the tendency to more robust or arborescent types, and in a good many cases pale or canescent foliage. I visited Santa Catalina many years ago, but only for a very brief visit, during which I found a new moth, described by Miss A. Braun, of Cincinnati, and a new snail, which I described. The validity of the snail has been disputed by California conchologists, but it has lately been reexamined by Dr. H. A. Pilsbry, who writes me that he finds it a good subspecies.

Until the present year (1937) I had failed to find an opportunity to reach the northern islands. On July 26, I was very kindly invited by a group of the Senior Boy Scouts to accompany them to San Miguel Island, returning on August 1. I was especially glad to have this opportunity, as no wild bees had ever been collected there,³ and there was every

² The local song sparrow of the Coronados Islands (*Melospiza melodia coronatorum*) is paler, with smaller bill.

³ I have since found that E. P. Van Duzee collected a bee (*Anthidium*) on San Miguel many years ago.

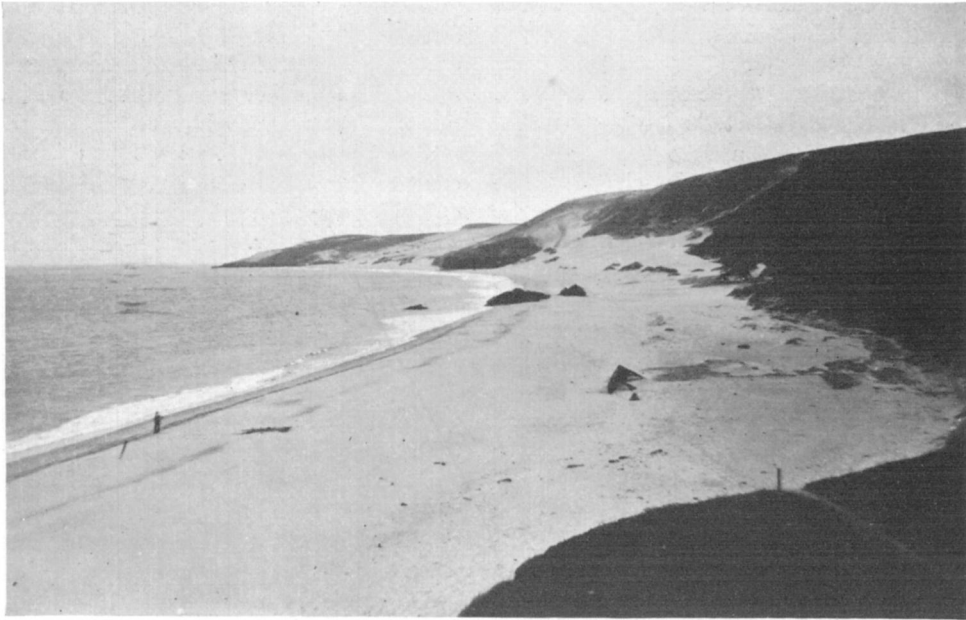
prospect of finding other insects of interest and possibly endemic forms of various groups. It took us five and a half hours to reach the island in a fishing vessel. The sea is very choppy in the Channel (recalling the English Channel), and several of us were seasick. The botanist E. L. Greene went to San Miguel in 1886, leaving Santa Barbara on August 19, and he relates that he and four others sailed in "a very small sloop, bearing a cargo of fence boards . . . that our voyage was not without adventure will be indicated by the testimony that we did not reach the shores of San Miguel until nine days later." But going to the other extreme, Mr. George Hammond, in his red aeroplane, makes the journey in twenty minutes, having a landing place on the flat top of the island.

San Miguel has a length of about $8\frac{1}{2}$ miles, with an average breadth of $2\frac{3}{4}$ miles; the area is estimated as 14 square miles. The highest points are 860 and 850 feet above sea level. The western end is about 25 miles south of the nearest mainland, but the sea between reaches a depth of over 250 fathoms. The nearest island, Santa Rosa, is only three miles away, and the channel is shallow, with a depth of only 17 fathoms.

We camped on the north side, at Cuyler's cove or harbor, the best landing place on the island. The Scout group, numbering about twenty, was in charge of Mr. John H. Leecing, Scout executive, of Santa Barbara, with the aid of Mr. J. W. Vickers, serving as cook, and Mr. M. McGregor, ready to render medical aid if necessary. The well-known efficiency of the Scouts was apparent throughout, and we all had a very good time. I climbed to the top of the island in two places, but some of the boys went all round.

The island consists largely of sand dunes, and must have been so for a very long while. Rocks of Tertiary age, near the shore, are tilted at an angle of per-

haps 50 degrees, and consist of solidified sand, with occasional layers of dense stone. They were not fossiliferous where examined, but they are referred to the Eocene by Bremner in his work on the geology of San Miguel. It was in an adobe like deposit, near the top of the island, that Mr. H. S. Lester found remains of elephants. Mr. Lester, who lives in the one ranch house on the island, had for years longed to hunt elephants in Africa, and it was considered rather a joke that he eventually found them close to his home on San Miguel. The undoubted Pleistocene beds containing *Elephas* have not been observed to contain other fossils, but it is reasonable to hope that something else may yet be found. On the top of the island, alternating with sandy deposits, I found a caliche or travertine-like deposit, very solid but composed of sand, and standing up on this are numerous objects which look like small trunks of trees, but are actually limy concretions formed around roots which formerly occupied the ground. Some people have thought that these objects were relicts of a former forest, but this is not the case. The roots were probably those of the Lemonadeberry, *Rhus integrifolia*, a kind of sumac which once abounded on the island, so that the wood is even now used for fuel. Greene reported that as far back as 1886 he saw only two or three of these shrubs, showing feeble signs of life, but he found the wood, in one case branches 30 feet long, but not more than a foot above ground. Hoffmann, of the Santa Barbara Museum, found one shrub overhanging the ocean bluff, on April 10, 1930. But on Princess Island, at the mouth of Cuyler harbor, the plant still survives and was found by the Scouts during our expedition. Two other more or less arborescent plants were found by Greene, but have now entirely disappeared. One is Toyon, *Photinia arbutifolia*, "two stunted specimens," and the other, of



CUYLER'S COVE, SAN MIGUEL ISLAND. —Scout Expedition photo

more special interest, is *Lavatera assurgentiflora*, the Malva Rosa or tree mallow. Greene tells of finding some thirty small trees of the *Lavatera* and also three or four depressed and straggling bushes at the very western end of the island. He commented that the San Miguel plant seemed to differ from those in cultivation; the branches much stouter, the leaves larger, the corollas of a deeper color, and the stellate pubescence of the pedicels and involucre a good deal more pronounced and conspicuous. Later, he found differences in the fruits, and many years after set up the San Miguel plant as a species, which he called *Saviniona dendroidea*. It has not been accepted by botanists, but presumably it constitutes a local subspecies, to be called *Lavatera assurgentiflora dendroidea*. Hoffmann, in all his explorations of the northern island, found *Lavatera* only once; four or five plants on a steep hillside above the old sheep landing, on Anacapa, on September 22, 1930.

There are thus no trees on San Miguel, if we except a fig tree (which duly bears figs) at the ranch house, where it is sheltered by the building. There has lately arisen considerable discussion concerning a project in which the Scouts were to have a part, for the "reforestation" of San Miguel. There is little reason to suppose that trees could be induced to grow in any numbers, but there are several good springs, and in the vicinity of these, especially in places more or less sheltered from the persistent high winds, it may be presumed that trees such as the lower-growing kinds of *Eucalyptus* would succeed. The experiment would cost little and is worth trying.

Although the list of species of plants on San Miguel shows only a small proportion of endemics, this list is swollen by the names of many plants certainly or probably introduced in recent years, and when it comes to the number of individuals, the endemics are conspicuous. The most conspicuous is the grey-green bladder-pod, *Astragalus miguelensis* of

Greene, which covers a large part of the surface. It is found on all the other northern islands (Hoffmann found it on Anacapa), but nowhere else in the world. Mr. Robert Brooks tells me that it acts on the sheep as a loco-weed, and is avoided by them. This circumstance favors the island snails, which cling to the branches of the *Astragalus* and would have difficulty in existing without it. These snails, a form of *Helminthoglypta ayresiana* (described from Santa Cruz) are very abundant, and have long existed on the island, as shown by their presence in the concretionary rock on the top of the island and in alluvial deposits near the shore, these surely antedating the period of human occupation. The shells are about as large as the end of one's thumb, and are light brown, with a broad white band on which is a very dark, nearly black, band. The subfossil shells are bleached white, but all show traces of the dark band. I searched long, but could find no other snails on the island; I suppose that any small forms, living on the ground, would soon be overwhelmed by the drifting sand.

Another island endemic, which occurs on San Nicolas as well as the northern islands, is the shrubby *Malacothrix implicata* of Miss Eastwood, regarded by recent writers as a variety of a mainland species. The white, daisy-like flowers are very conspicuous on the cliffs by the shore, and I found them attractive to wild bees.

The yellow-flowered *Erysimum insulare* of Greene, related to the garden wall flower, is very abundant, and noteworthy for the spreading instead of erect pods. This was described as an endemic, but has lately been taken from the list, as it occurs in some quantity in one district on the mainland. I am inclined to suppose that it is a genuine island endemic, and has been introduced on the mainland in comparatively recent times. I can even imagine that the yellow-spined

prickly pear, *Opuntia littoralis*, so characteristic of the islands, owes its presence on the mainland to introduction by man; but should this be true, there would be no possibility of proving it.

The ice-plant, *Mesembryanthemum crystallinum*, is excessively abundant, and in case of need will keep animals alive in the absence of water. But Mr. Robert Brooks tells me that it acts as a purgative on the sheep, and is generally avoided by them. This plant is generally supposed to have been introduced from Africa, but Greene thought it was native, and it may be one of the group of strand plants, such as certain *Convolvulaceae*, which have been spread widely over the world, presumably through the agency of birds. I do not know whether the African and Californian plants have been carefully compared in the living state; as herbarium material they are almost unrecognizable.

There is much grass on the island, including a tall and very robust form of rye grass, *Elymus condensatus*, growing in the vicinity of springs, mixed with the introduced beard grass, *Polypogon monspeliensis*. Among the specimens I brought back Mrs. Agnes Chase, of Washington, recognized *Distichlis dentata* Rydberg, a plant new to the islands, and not given by Munz in his *Manual of Southern California Botany*, although they have a specimen at Washington which was collected in Orange County.

We did not plan to collect vertebrates, but Bruce Davis, one of the Scouts, found a specimen of the very interesting endemic salamander, *Batrachoseps pacificus*, by the spring at the landing place. It is a worm-like creature, with short legs; our specimen is darker than the descriptions indicate, at least as preserved in alcohol. Mr. Davis said that it appeared more brightly colored when alive. We also obtained a specimen of the endemic white-footed mouse, *Peromyscus maniculatus strea-*



—Scout Expedition photo

CONCRETIONS

RESEMBLING TRUNKS OF TREES, ON TOP OF SAN MIGUEL ISLAND.

tori, which was skinned by Mr. McGregor. This was not considered important at the time, but it proved to be of unusual interest. At the Santa Barbara Museum, Mr. E. Z. Rett showed me three mice from San Miguel and a dozen from Santa Cruz, the latter belonging to the subspecies *P. m. santacruzae*. The Santa Cruz mice, about half from near the beach and half from the central part of the island, all look alike, and are very dark. The tails vary from 77 to 92 mm long. The three San Miguel mice are much paler and redder, and are smaller, the tails 66 to 71 mm. But the mouse I brought back was considerably darker than Mr. Rett's series, with a dark dorsal stripe, and the tail 78 mm. On examining the skulls, Mr. Rett found that his three mice were all very immature, while mine was adult. Thus it appears that the characters of the San Miguel race are more evident in the young mice than in the adults. The pale color is what might be expected in a sandhill species. The

tracks of the mice indicated their abundance on San Miguel, and Mrs. Lester told me that some time ago they were so numerous as to amount to a plague, and they had to destroy them around the ranch house, by traps and poison, to such an extent that they were buried in trenches. Hearing this, I lamented the waste of so many specimens of this endemic race, hardly represented in museums. We hope to see a good series secured for the Santa Barbara Museum.

The insects obtained will be reported on later.⁴ Among the smaller insects, I expect to find few endemics, as they can be blown from the mainland by the strong prevailing winds. Collections made in the air by means of aeroplanes have demonstrated that many small insects are thus transported. Spiders, when young, can travel on their gossamer

⁴ I have since worked up the bees. I find I collected sixteen species, of which seven are new species, and five others new races of mainland species.

threads. Many years ago, the well-known zoologist Eisen collected ten species of spiders on Santa Rosa, and these were recorded in 1904 by Dr. N. Banks. Two of them were new species and peculiar to Santa Rosa, so far as the records then showed. Of butterflies, I found on San Miguel only two species, a *Lycaenid* or "blue," and a small yellow skipper which I failed to catch. There are probably others, but they can not be nearly so numerous as on Santa Catalina, where 27 species were taken by Don Meadows. The few moths taken were pale colored, like the sandhill species of other countries. A kind of mealy-bug, perhaps new, was found on *Astragalus miguelensis*. The females can not fly, and the males fly feebly, but the young larvae can be transported on the feet of birds. We found cricket-like orthoptera, entirely wingless, of the genera *Stenopelmatus* and *Ceuthophilus*, and these may well prove to be endemic.

Mr. M. E. Rodehaver very kindly took several of us over to Princess Island, a small island at the entrance to the bay. It is commonly called Prince or Prince's Island, and is so marked on maps, but Hoffmann, in his herbarium, always wrote Princess. Mr. Brooks states that the name was due to a legend of an Indian "princess," whose conduct was not approved of, and who was transported to the island, where she would soon have perished. Princess Island has been chiefly known as the breeding place of innumerable sea birds, especially pelicans (*Pelicanus californicus*), cormorants and gulls. It is quite steep, and so covered with ice-plant that it is slippery and hard to climb. There is a good deal of prickly-pears (*Opuntia littoralis*), but the common *Astragalus* and *Erysimum* of the main island appear to be entirely absent. There are no snails, so far as I could discover. The boys found *Rhus*, as already mentioned, and on the top blackberry



THE TOP OF SAN MIGUEL ISLAND —Scout Expedition photo
WITH SHIFTING SAND DUNES, LARGELY COVERED WITH *ASTRAGALUS MIGUELENSIS*.

(*Rubus vitifolius*), which had previously been collected there by Hoffmann. A single bee (*Agapostemon*) was found in a spider's web.

We had no opportunity to make any study of the marine mammals, but seals (*Phoca richardii geronimensis*) were seen about Princess Island, and many dead ones were found on the shores of the main island, shot by the fishermen. In addition to the common seal, no less than four different marine mammals (exclusive of Cetacea) have been found about the islands, namely, the Guadalupe fur seal, the northern elephant seal, the Steller sea-lion and the California sealion. The first of these has not been seen for some years. Mr. D. B. Rogers reports remains of the Guadalupe fur seal and elephant seal in Indian middens. The kitchen middens of the ancient Indians are very conspicuous on San Miguel, consisting mainly of great heaps of shells of the edible mussel (*Mytilus*), with numerous red abalones. Rogers (1929) recognizes three successive types of aboriginal inhabitants on the mainland of Santa Barbara County. The first or earliest, called the Oak Grove People, offer remains in great abundance, but of such fragmentary nature and so imbedded in a semi-fossil state in a strong matrix that their recovery and restoration are extremely difficult. The second group is called the Hunting People, and the third the Canalina People. The latter are supposed to have been in full possession of the entire region as early as 1000 A. D., and these are the people found by J. R. Cabrillo when he discovered the islands in 1542. The

matrix in which the Oak Grove remains occur may possibly be contemporaneous with and similar to the dense deposit, containing snail shells, on the top of San Miguel.⁵ On San Miguel, it appears to be definitely older than any of the Indian remains, but this should be expected, as according to Rogers the first two types of inhabitants never reached the islands. It was the Canalina type, presumably coming from the north, who had boats, and colonized the islands.

The recorded birds of San Miguel appear to number only 41 kinds, as against 149 from Santa Cruz. This may be partly due to the fact that Santa Cruz has been more frequently visited by collectors, but in the main it is an expression of the comparative poverty of the island, with a comparatively limited fauna and flora. Mr. Brooks states that the white-headed eagles (*Haliaeetus leucocephalus*) do attack the sheep, but are not nearly so injurious as the ravens (*Corvus corax sinuatus*), which prey on the young lambs as they are born. A form of song-sparrow (*Melospiza melodia micronyx* of Grinnell) is peculiar to San Miguel.

⁵ Mr. Rogers thinks that this is not the case. He agrees with me that this deposit appears to be older than the middens on the island and must antedate the coming of the Indians. Bremner, in his "Geology of San Miguel Island" (published by the Santa Barbara Museum, 1933) has a very good figure of the deposit, marked "Sand cemented with calcium carbonate, preserving the forms of roots and stumps of vegetation destroyed in the past century," but he gives no reasons for assigning such a recent date. The shells in the middens have not disintegrated, and the calcium carbonate is probably derived from minute fragments of shells in the sand.